Department Elective – II	**L**	**T**	**P**	**C**
Fifth year of Five Years integrated M. Sc. (Physics)				
M.Sc. - V, Semester – IX	**3**	**0**	**0**	**3**

MP 553: Material Science

- **INTRODUTION TO CRYSTAL GROWTH** **(06 Hours)**
  Materials and civilization, structure properties performance, classification of materials, states of matter, theory of liquids, transition between states of matter, energetics of transitions, structure of solids, crystallization, three dimensional bonding, interatomic distances, generalization based on bonding, formation of amorphous solids, metallic glasses, colloidal state of matter, gels, emulsions, liquid crystals, plasma state of matter, advanced materials, composite materials, modern materials needs, Polymeric materials, Organic Semiconductors, Ceramics.

- **PHASE EQUILIBRIUM AND NUCLEATION** **(08 Hours)**
  Phase diagrams, definition and basic concepts, Gibb's phase rule, one component and two component phase diagrams, properties of phases in materials, crystalline and non-crystalline phases, practical aspects of phase diagram, non-equilibrium in phase diagrams, iron carbon alloy, Phase deformation in materials, nucleation, growth of nuclei, solidification of alloys, common phase transformations in solid materials.

- **GROWTH TECHNIQUES** **(08 Hours)**
  Crystal Growth from Melt, Solution, Vapour, Hydrothermal synthesis etc., Epitaxial Techniques, Liquid Phase Epitaxy, Vapour Phase Epitaxy, Metal Organic Chemical Vapour Deposition (MOCVD), Molecular Beam Epitaxy (CBE), Atomic Layer Epitaxy (ALE)

- **MATERIAL PROPERTIES AND CHARACTERIZATION** **(08 Hours)**
  Points defects in solids, lattice vacancies, colour centres produced by irradiation with x-rays, methods of characterizations, single crystal technique, Fourier computational methods, techniques and applications of neutron diffraction, comparison of neutron and X-ray diffraction, Elastic and plastic behaviour of materials, viscous and viscoelastic deformation, character of plastic flow, deformation of crystalline materials, plastic deformation, creep fracture, fatigue, hardness, Magnetic properties, types of magnetic materials, applications, Optical properties of metals and non-metals, optical materials, luminescence excitation and emersion, decay mechanisms, thallium activated alkali halides, electroluminescence.

- **NANOMATERIALS** **(06 Hours)**
  Intoroduction to nanomaterials, Fabrication of nanomaterials, Properties of materials at nano-scale, The era of new nanostructures of Carbon, Carbon Nano Tubes, Characterization of nanostructures, SPM, STM, AFM, SEM, TEM.

- **MATERIALS DESIGN FOR SEMICONDUCTOR DEVICES** **(06 Hours)**
  Semiconductor optoelectronic properties, III-V materials selection, semiconductor device structure for laser diodes, light emitting diodes (LED's), Photo cathodes, Microwave field-effect transistor.

(Total Contact Hours (Theory) : 42 Hours)

BOOKS RECOMMENDED:

1.	**Callister W.D.**	*Materials Science and Engineering*	Wiley	1997
2.	**Hertyman P.**	*Crystal Growth*	Elsevier	1973
3.	**Guy A.G.**	*Essentials of materials science*	McGraw Hill	1976
4.	**Pemplin B.R.**	*Crystal Growth*	Pergamon Press	1980
5.	**Vanvleck L.H.**	*Elements of Materials Science and Engineering*	Addison Wesley	1999